G0 Analysis Update

John Schaub
NMSU

Hall C Meeting, JLab

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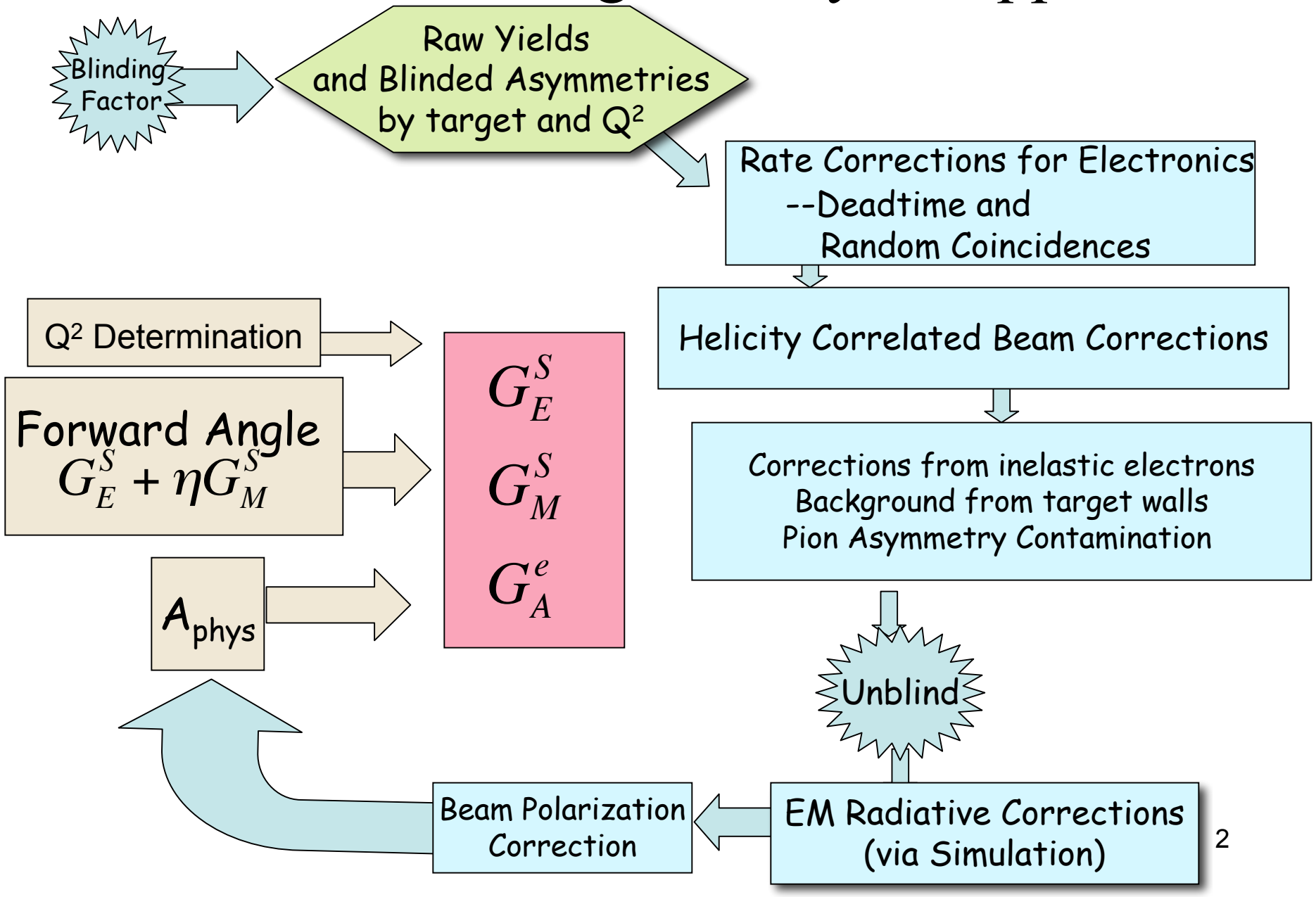
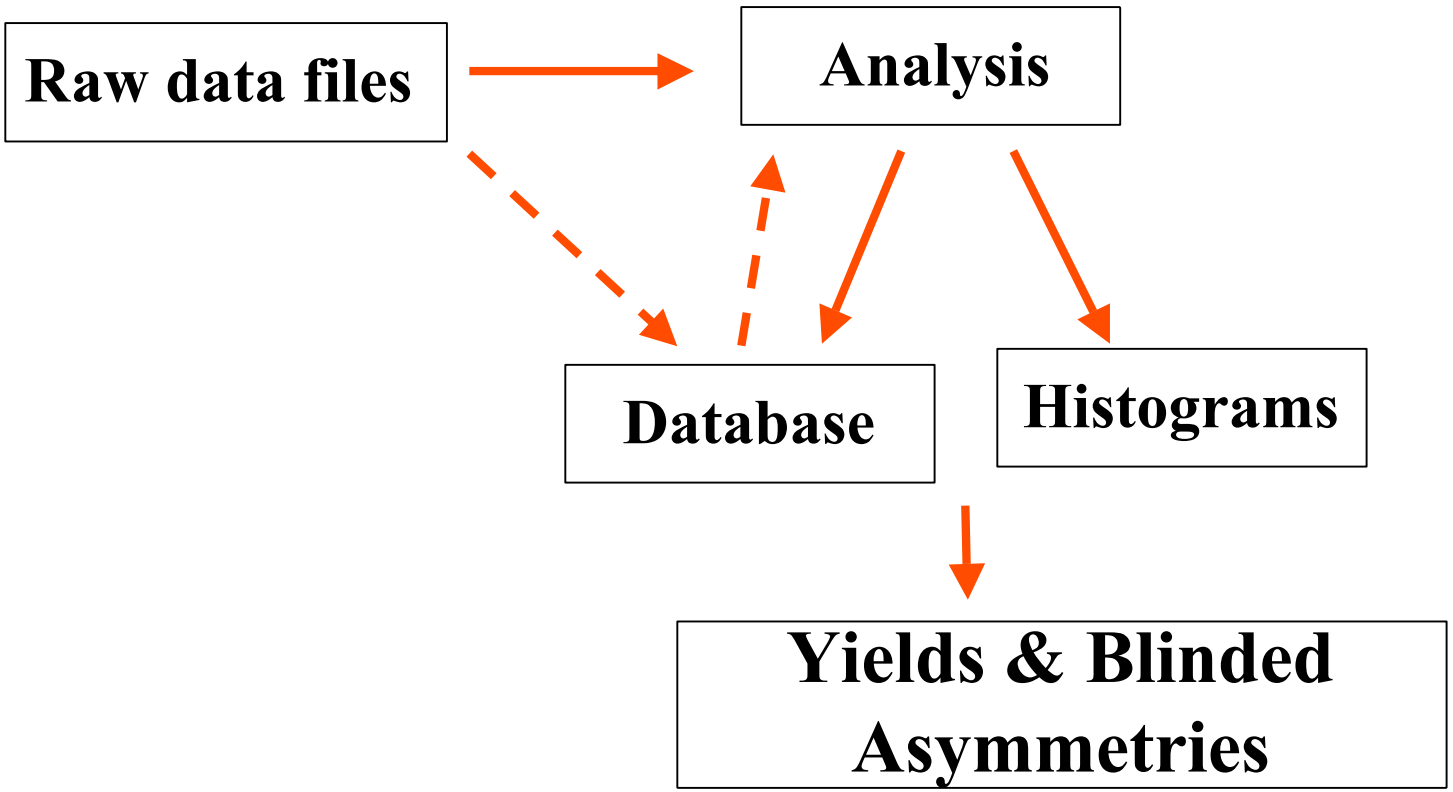
G0 Backward Angle Analysis Approach



G0 Analyzer


Raw data files
Analysis
Database
Histograms
Yields & Blinded Asymmetries

Asymmetry Analysis

(Four Analysis Passes)

Beam calibrations

- **Pass 1:**
  - **Uncorrected yields and blinded asymmetries**

→

- **Pass 2:**
  - **Scaler counting correction**

↓

- **Pass 3:**
  - **Electronic corrections**

    (deadtime, randoms, contamination)

←

- **Pass 4:**
  - **Linear regression correction**

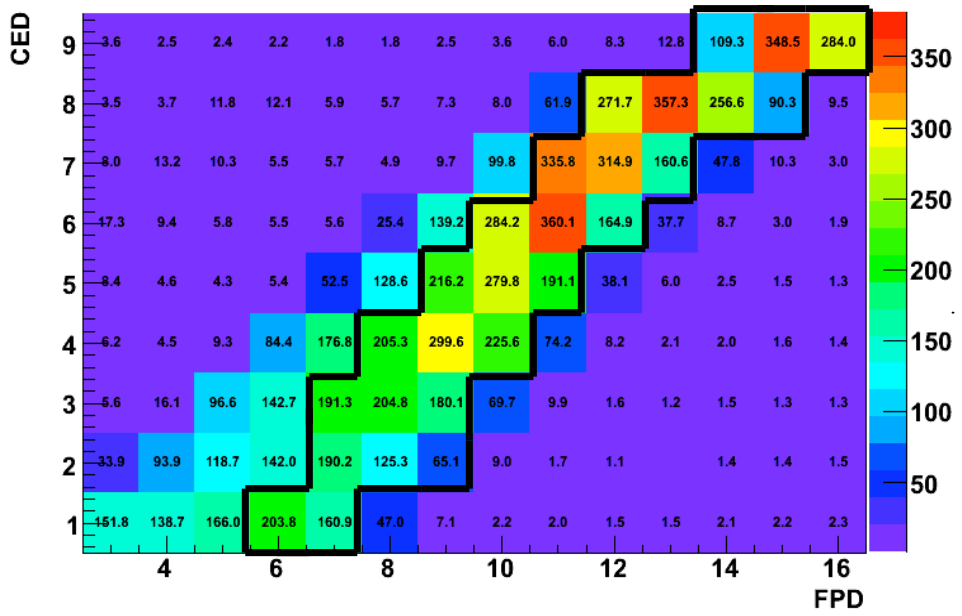
Pass 1

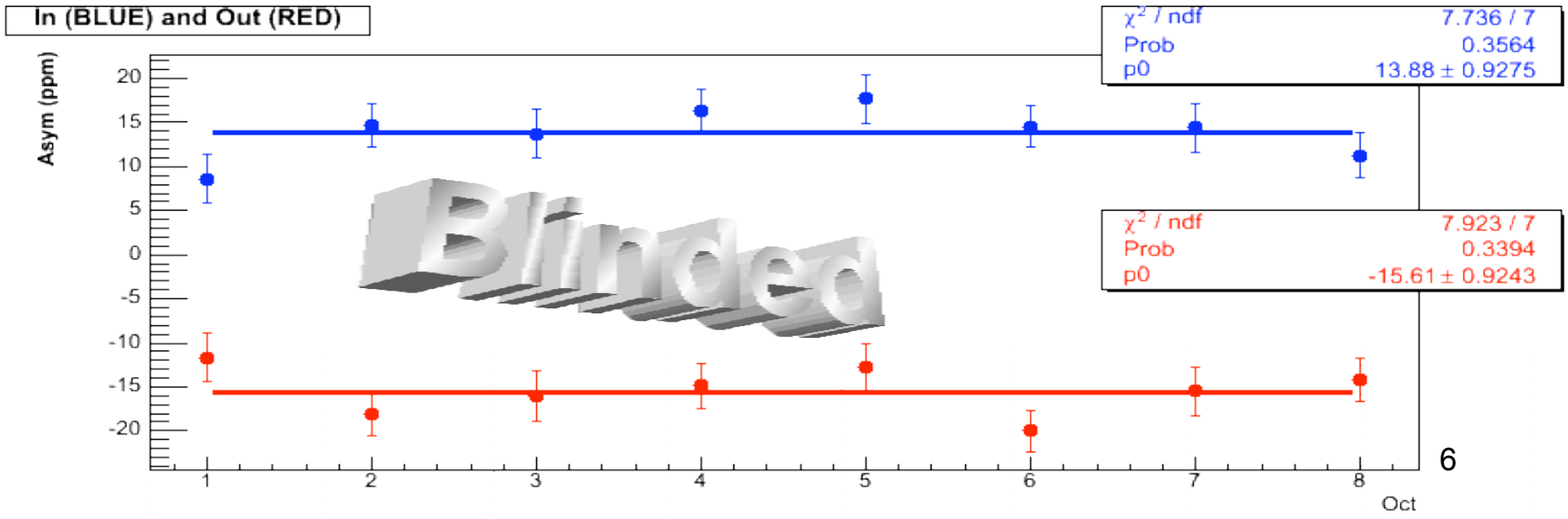
Uncorrected Yields
and
Blinded Asymmetries

Preliminary Yields and Blinded Elastic Asymmetries

362MeV
LD2

70 C





Pass 2

Scaler Counting Correction

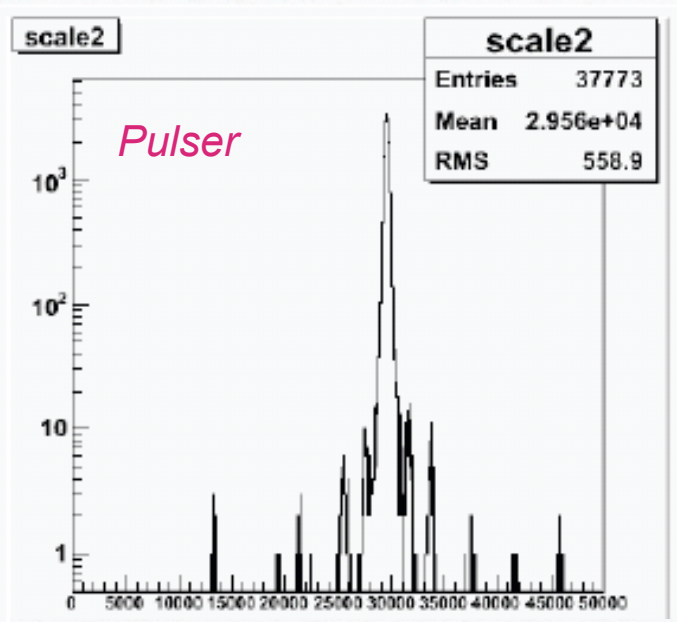
Scaler Counting Problem

- Electronics sorts detector coincidences (CED_i and FPD_j) into separate scaler channels
  - FPGA-based system in North American electronics (4 octants)

- Because of error in FPGA programming, two short (~3 ns) pulses could be sent to scaler in < 7 ns--problem for 140MHz scaler
  - Such a pulse pair could cause scaler to drop or add a random bit

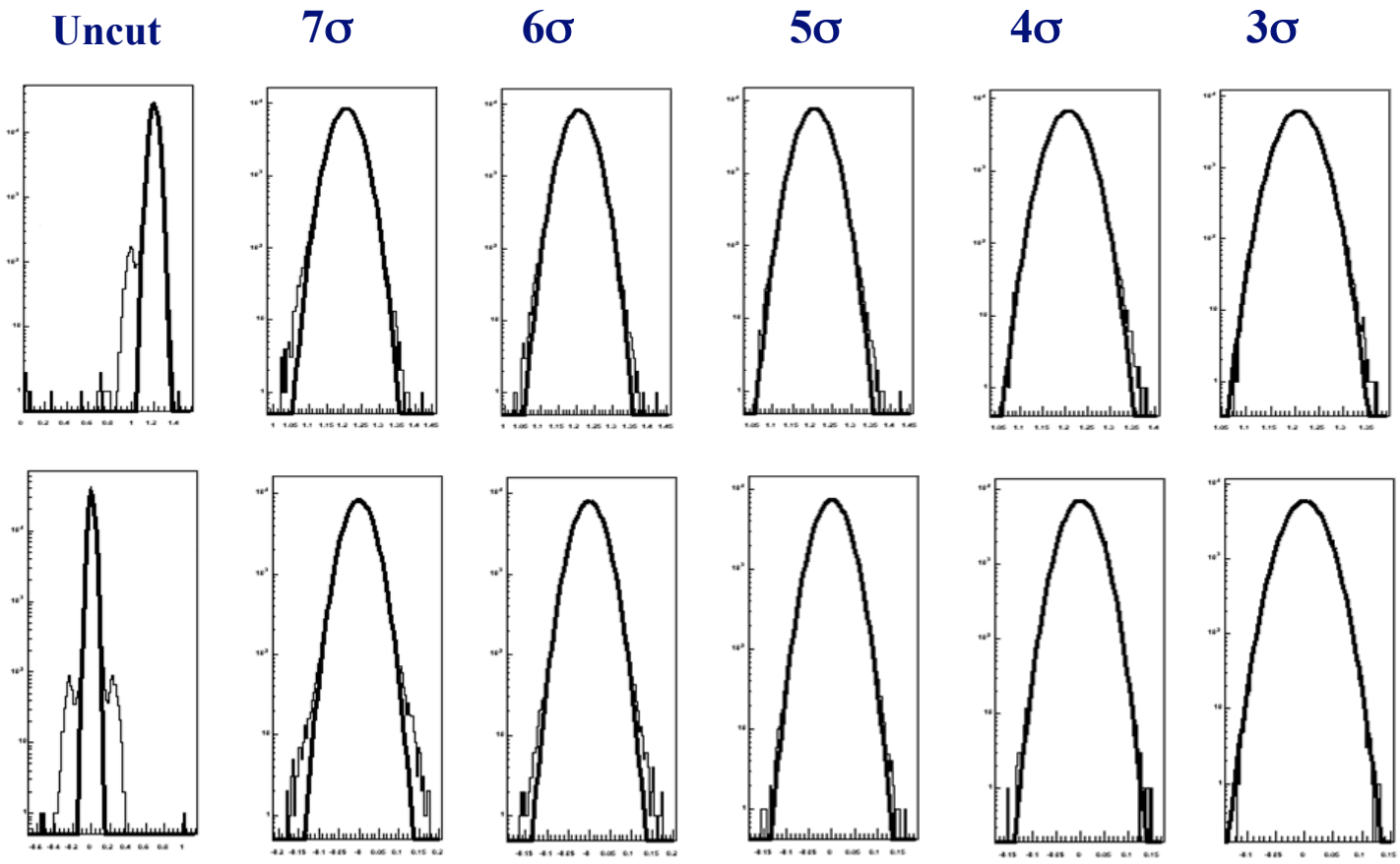
- Problem blind to helicity
- ~ 1% of events have such miscounts
  - Problem pronounced in high-rate kinematics

- Preliminary assessment: effect on asymmetry is a small fraction of statistical uncertainty
  - Test by cutting data; compare with French octants
  - Confirmed by unchanged asymmetry after fix



Yield Cut/Asymmetry Effect

Coincidence cell CED9/FPD16, 15 runs chained



Cut on yield (per macropulse) …

…effect on asymmetry

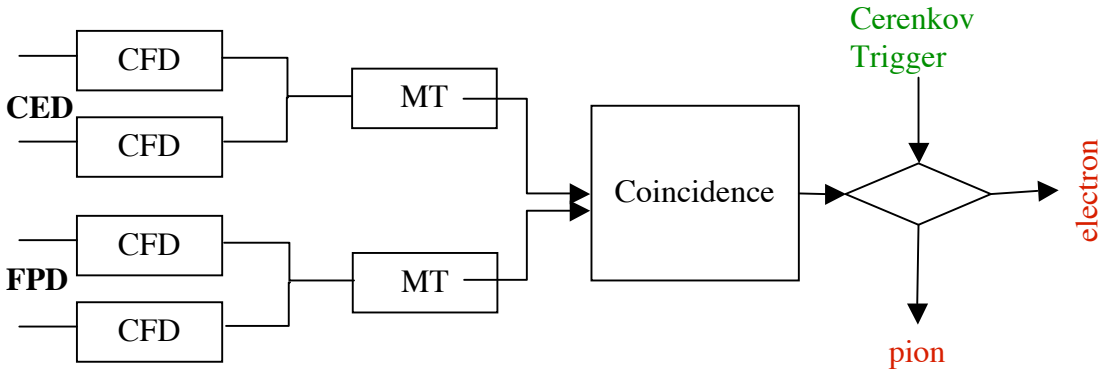
5σ cut removes ~1% of our data for 362MeV LD2

Pass 3

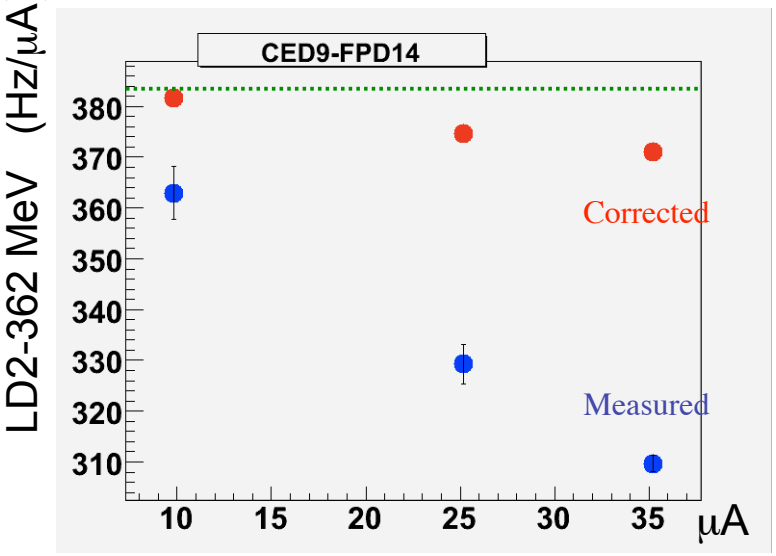
Electronics Corrections

Electronics Corrections

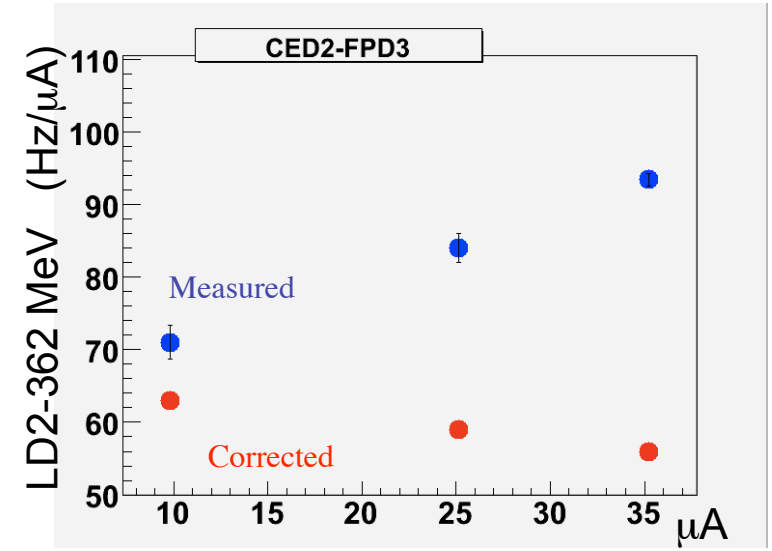
CED-FPD Coincidence Deadtime



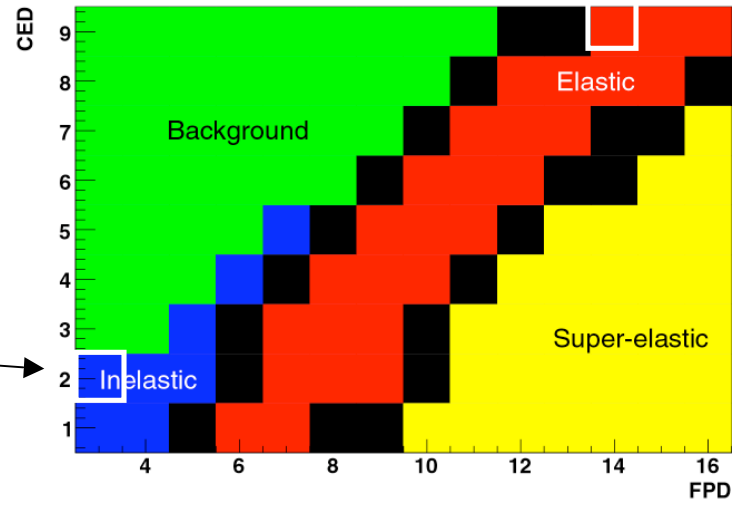
Electron Measured & Corrected Yields



Electron Measured & Corrected Yields



Matrix Space Cuts - 362 MeV

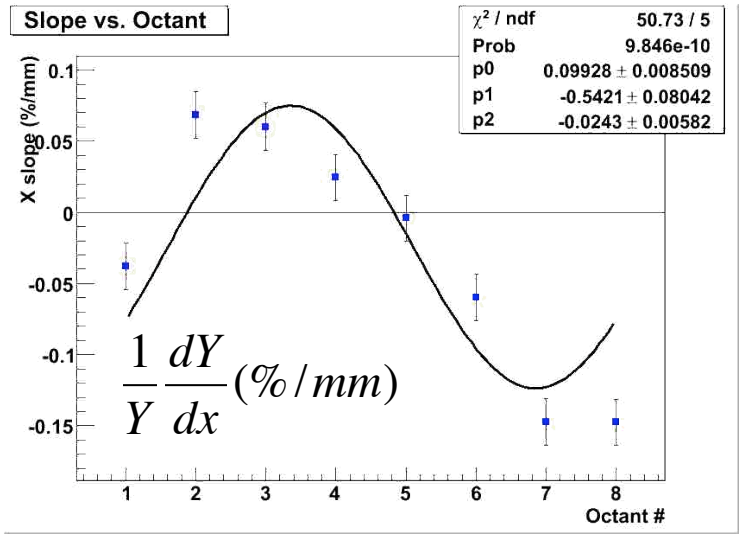


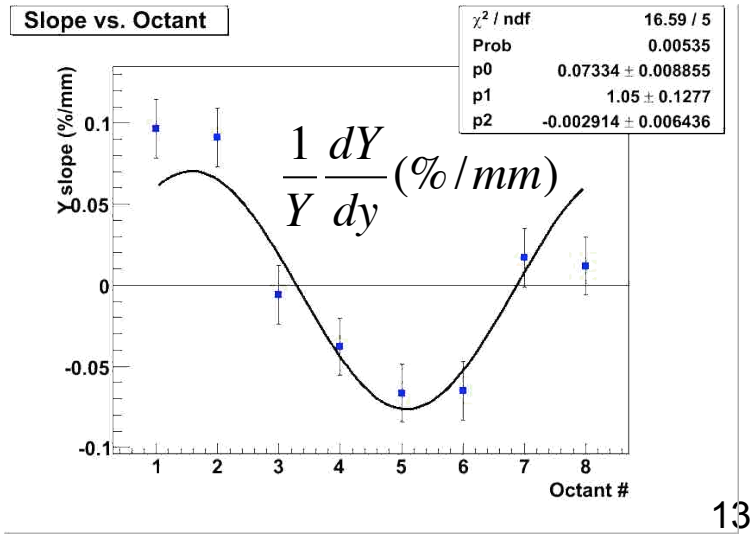
Pass 4

Helicity-Correlated Corrections

Helicity-Correlated Beam Properties: Linear Regression

- Cross check slopes from natural beam motion with those from deliberate ‘coil-pulsing’ runs
- Sensitivities to helicity-correlated beam motion smaller at backward angles (data and simulation)



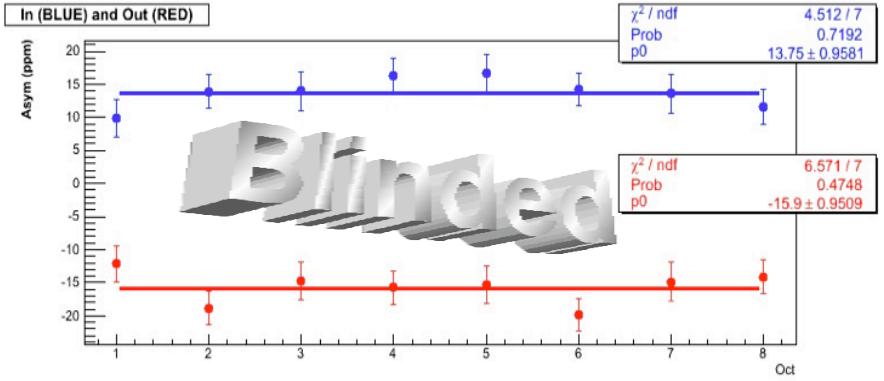


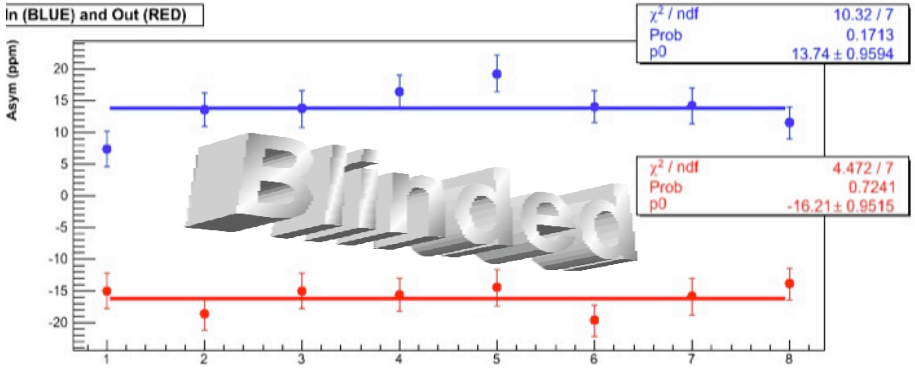
Linear Regression Summary

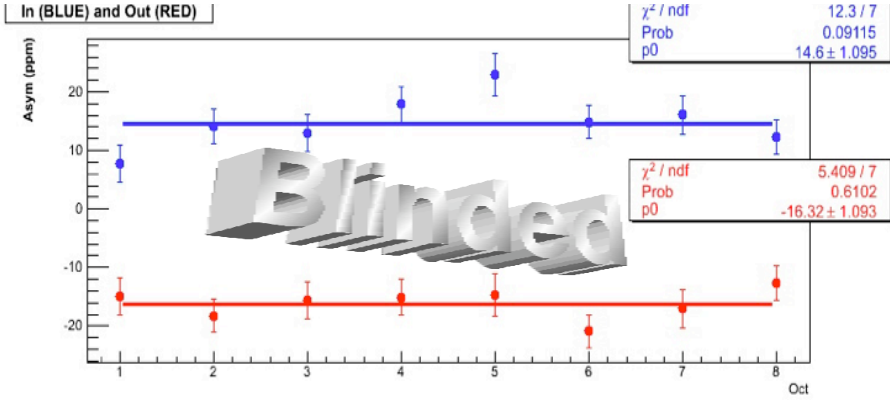
- Elastic Electron False Asymmetries

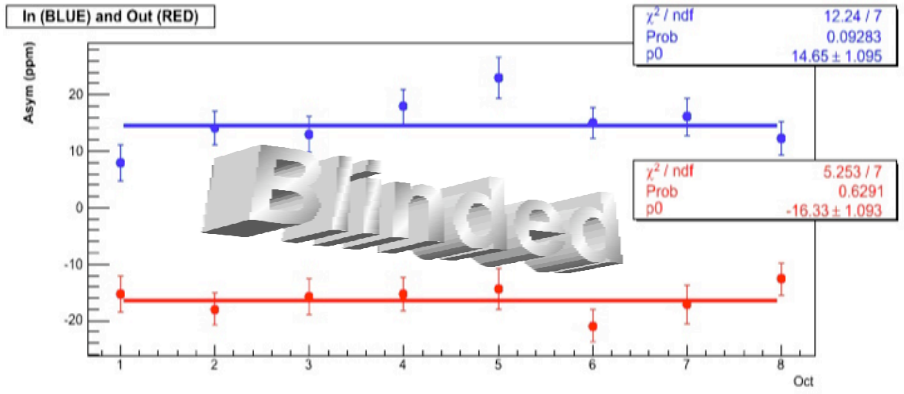
	Pass 3	Pass 4
q (ppb)	-0.42 ± 0.46	< 0.0069
X (ppb)	0.5 ± 2.1	< 0.063
Y (ppb)	0.5 ± 3.5	< 0.26

Four Pass Asymmetries









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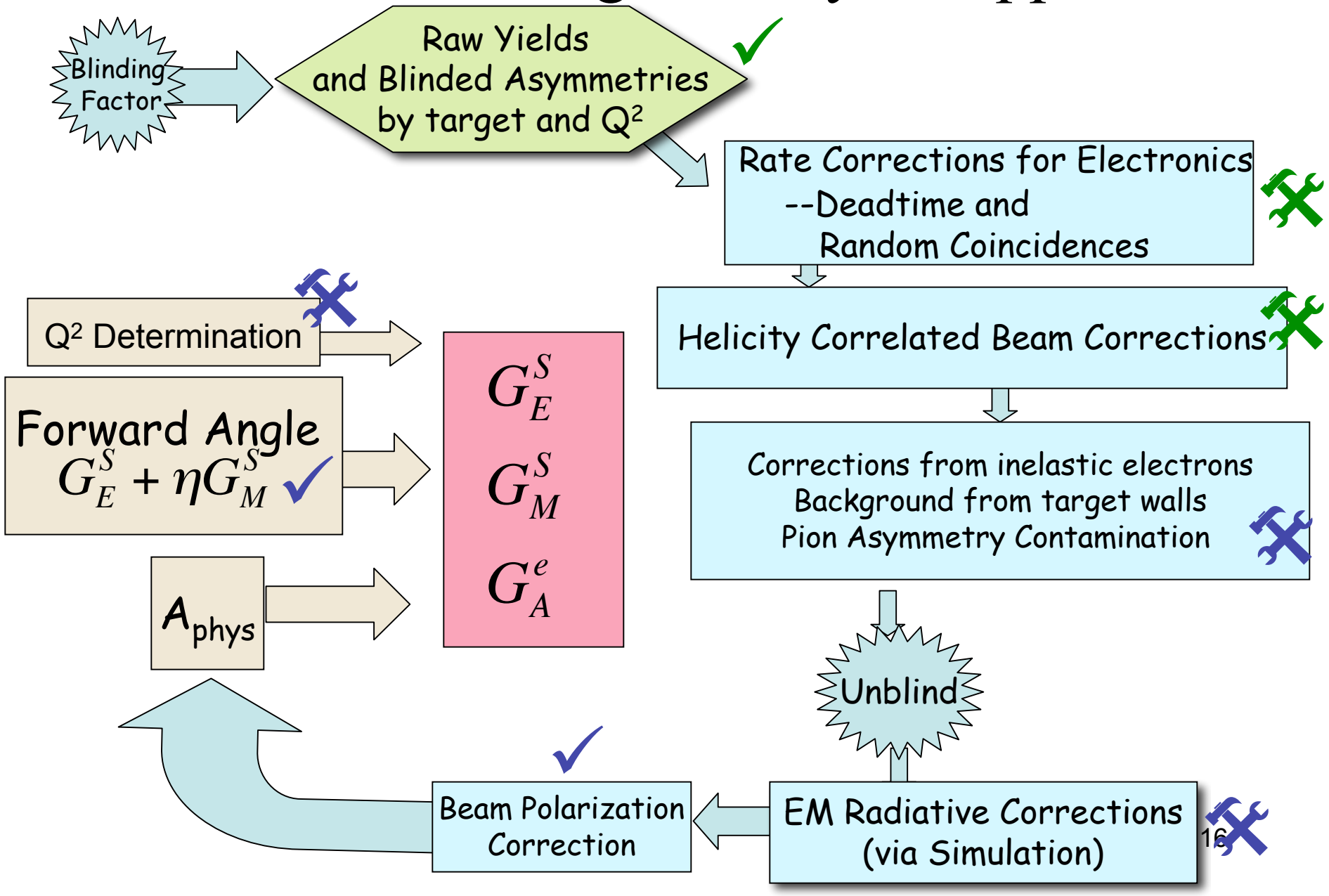

“The strangeness will wear off and I think we will discover the deeper meanings…”

-Jackson Pollock

Backup Slides

Induced Asymmetry Analysis : A_{det} vs A_I

$$A_{\text{det}} = A_{true} + A_{false}$$

Independent of A_I	Electronics related part strongly dependent of A_I

Total False Asymmetry related to the Global Dead Time correction:

$$\begin{aligned}
\mathbb{A}_{\text{false}} = \quad & f_{\text{rand}} \left[-\mathbb{A}_{\tilde{r}_{coinc}} + \mathbb{A}_I + \mathbb{A}_{\tilde{r}_{ced}} + \mathbb{A}_{\tilde{r}_{fpd}} \right] \\
- \quad & DT_{\tilde{r}_{ced}^{Single}} \left[\mathbb{A}_{\tilde{r}_{ced}^{Left}} + \mathbb{A}_I \right] - DT_{\tilde{r}_{fpd}^{Single}} \left[\mathbb{A}_{\tilde{r}_{fpd}^{Left}} + \mathbb{A}_I \right] \\
- \quad & DT_{\tilde{r}_{ced}^{Single}} \left[\mathbb{A}_{\tilde{r}_{ced}^{Right}} + \mathbb{A}_I \right] - DT_{\tilde{r}_{fpd}^{Single}} \left[\mathbb{A}_{\tilde{r}_{fpd}^{Right}} + \mathbb{A}_I \right] \\
- \quad & DT_{\tilde{r}_{ced}^{MT}} \left[\mathbb{A}_{\tilde{r}_{ced}^{MT}} + \mathbb{A}_I \right] - DT_{\tilde{r}_{fpd}^{MT}} \left[\mathbb{A}_{\tilde{r}_{fpd}^{MT}} + \mathbb{A}_I \right] - DT_{trigger} \left[\mathbb{A}_{\tilde{r}_{coinc}^{all}} + \mathbb{A}_I \right] \\
- \quad & MH_{12} \left[+\mathbb{A}_I - \mathbb{A}_{\tilde{r}_{ced}^{all}} + \mathbb{A}_{\tilde{r}_{fpd}^{all}} \right] - MH_{12} \left[+\mathbb{A}_I - \mathbb{A}_{\tilde{r}_{coinc}^{other}} \right]
\end{aligned}$$

where :

- f_{rand} is the fraction of CEDxFPD random coincidences
- DT is the probability of dead time associated with each dead time source, *i.e* left and right singles, mean timers, and trigger
- MH is the probability of having a multihit
- $\tilde{r}$ is the normalized rate of resp. coincidences, CED's CFD+MT and FPD's CFD+MT.